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Interventions and Management

1. Chondrodesis of the wrist in children with severe paralytic hand deformities.

Boulahouache A, Cambon-Binder A, Chouiha M, Lardjane ML, Belkheyar Z.

Hand Surg Rehabil. 2020 Mar 31. pii: S2468-1229(20)30064-5. doi: 10.1016/j.hansur.2020.02.007. [Epub ahead of print]

We examined the anatomical and clinical results of a new wrist subphyseal arthrodesis method called chondrodesis, which relies on resorbable suture-bone fixation for children with severe paralytic hand deformities and does not require fixation devices or bone grafting. Four children's wrists underwent the procedure, resulting in three successful wrist bone fusions. The wrists were stabilized by joint fusion in 4-5 months in good positions, ranging from neutral to extension 15°, while still allowing the forearm to keep growing since the radial growth plate remained open as of the last follow-up. The procedure improved hand function (House score, Raimondi score) and appearance. It also increased control over gripping motions with the operated hand, and even restored key pinch ability in one of the patients. The youngest patient was not able to achieve bone fusion at the key sites and will need further corrective procedures at a later and more optimal age. This novel procedure is appealing because of its technical reproducibility, low cost, encouraging outcomes, ease of rehabilitation, and because it spares the physal cartilage.

PMID: [32244070](#)

2. A perspective on the development of hemispheric specialization, infant handedness, and cerebral palsy.

Ferre CL, Babik I, Michel GF.

Cortex. 2020 Mar 10;127:208-220. doi: 10.1016/j.cortex.2020.02.017. [Epub ahead of print]

Cerebral Palsy (CP), a common form of neurological pediatric disability, results from pre- or perinatal brain injury. Although there is growing evidence of the efficacy of motor learning-based therapies, several factors interact to produce variability in impairment and limit the effectiveness of these therapies. The variability of hand function present in children with CP indicates that a range of developmental pathways must contribute to the manifestation of individually unique characteristics of impairment. Despite two decades of progress using therapies derived from understanding the mechanisms controlling hand function, very little is known about the sensorimotor experiences occurring during development that likely shape later functional problems for children with CP. In this "perspective" paper, we propose that the study of the development of motor skills in typically developing infants may reveal experiential factors potentially important for creating remedial therapies for children with CP. Specifically, we use the development of infant handedness, a model of hemispheric specialization of function, as an example of how self-generated experiences and sensorimotor feedback can shape the development of limb control and hemispheric specialization. We illustrate how early sensorimotor asymmetries concatenate into pronounced differences in skill between the two hands. We suggest that this model of infant handedness provides a framework for studying the individual differences manifested in children with CP. These differences likely arise from aberrant sensorimotor

experiences created by sensorimotor circuits disrupted by the early brain injury. We conclude that knowledge of the developmental events, including subtle motor behaviors, that shape sensorimotor pathways, can improve treatment options for children with CP.

PMID: [32224319](#)

3. Botulinum Toxin A Injection in Treatment of Upper Limb Spasticity in Children with Cerebral Palsy: A Systematic Review of Randomized Controlled Trials.

Farag SM, Mohammed MO, El-Sobky TA, ElKadery NA, ElZohiery AK.

JBJS Rev. 2020 Mar;8(3):e0119. doi: 10.2106/JBJS.RVW.19.00119.

BACKGROUND: Cerebral palsy (CP) is the most common cause of childhood disability globally. Botulinum toxin A injections are widely used to manage limb spasticity in children with CP. Intramuscular botulinum toxin A has been used in the upper limbs of children with CP to manage preoperative and postoperative pain, facilitate nursing, and achieve functional and/or cosmetic improvement of hand position. These goals are achieved primarily through reduction of spasticity. The aim of this review was to assess the evidence for the effect of botulinum toxin A injections used to manage upper limb spasticity in children with spastic CP. Specifically, we examined the role of botulinum toxin A as an adjunctive treatment to other physical therapy modalities. Additionally, we analyzed the associated complications. **METHODS:** The literature extraction process involved 4 phases: identification, screening, eligibility, and inclusion. We used a combination of Google Scholar, PubMed, and ScienceDirect. The choice of the search terms was based on the Medical Subject Headings. We extracted the relevant studies using a combination of words or terms related to (1) patient population, (2) pathology, (3) clinical intervention, and (4) anatomical distribution of pathology. Studies were included if they were randomized controlled trials conducted on children and/or adolescents with CP targeting the upper extremities in which botulinum toxin A was used as an adjunctive treatment to a primary intervention. **RESULTS:** The literature extraction process yielded 15 randomized controlled trials for inclusion in this review. The total number of participants enrolled in the included studies was 499, with 255 in the intervention group (51%) and 244 controls (49%). All participants in the eligible studies had unilateral spastic CP except for those in 4 studies (27%) with 198 participants (40%) that included a heterogeneous sample of unilateral and bilateral spastic CP. The mean age of participants in the intervention group ranged from 2.6 to 10.7 years among the individual studies. The mean age of participants in the control group ranged from 3.1 to 10.55 years among the individual studies. This review indicated that botulinum toxin A had a positive effect on the degree of spasticity and cosmetic appearance of the injected upper limb. The results with respect to functional gains and quality of life were either conflicting or not significant. **CONCLUSIONS:** Randomized controlled trials of botulinum toxin A injection in the treatment of upper limb spasticity in children with CP used variable outcome measures and yielded mixed results. Overall, there is some evidence to support the use of botulinum toxin A as an adjuvant treatment to other physical therapy regimens or placebo to reduce spasticity in the short term. There is insufficient evidence to support its use as an adjunctive treatment to improve upper limb function or quality of life. The complications were acceptable and did not outweigh the clinical gains incurred. **LEVEL OF EVIDENCE:** Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

PMID: [32224633](#)

4. The positive and the negative impacts of spasticity in patients with long-term neurological conditions: an observational study.

Ayoub S, Smith JG, Cary I, Dalton C, Pinto A, Ward C, Saverino A.

Disabil Rehabil. 2020 Mar 30;1-8. doi: 10.1080/09638288.2020.1742803. [Epub ahead of print]

Purpose: To describe the positive and negative impacts of spasticity across different neurological disorders using the Patient Reported Impact of Spasticity Measure (PRISM), deduce any associations between severity of spasticity and its impact, and assess for differences across diagnostic subgroups. **Materials and methods:** PRISM, a spasticity-specific quality of life questionnaire validated in patients with spinal cord injuries, was given to 97 follow-up patients attending a spasticity clinic prior to symptom assessment using the REsistance to PASSive movement Scale (REPAS). **Results:** Patients described a minor level of positive impact and a marked negative impact in the domains of "Psychological Agitation," "Daily Activities," "Need for Assistance/Positioning" and "Social Avoidance/Anxiety." Spasticity severity was, in general, a poor predictor of perceived impact, although severity and localisation of spasticity was modestly correlated with "Need for Assistance/Positioning" and "Social Embarrassment" levels. Despite comparable levels of spasticity severity, people with MS expressed a more substantial impact across some PRISM domains than did patients in other groups. **Conclusion:** PRISM can be useful to assess the impact

of spasticity in various neurological conditions although further validation studies are needed. Implications for Rehabilitation. The localisation of spasticity in both legs or the right arm can produce a significant impact on 'Need for Assistance/Positioning' and 'Social Embarrassment'. People with MS may experience a greater impact of spasticity than those with other neurological conditions, particularly in the domains of Social Avoidance/Anxiety and Psychological Agitation. Coexisting factors such as anxiety, depression, fatigue and pain should be investigated together with spasticity. PRISM can assist in goal setting and treatment of people with spasticity secondary to different neurological conditions.

PMID: [32223455](#)

5. Multi-frequency bioimpedance: a non-invasive tool for muscle-health assessment of adults with cerebral palsy.

Pingel J, Harrison A, Von Walden F, Hjalmarsson E, Bartels EM.

J Muscle Res Cell Motil. 2020 Mar 27. doi: 10.1007/s10974-020-09579-2. [Epub ahead of print]

Muscle contracture development is a major complication for individuals with cerebral palsy (CP) and has lifelong implications. In order to recognize contracture development early and to follow up on preventive interventions aimed at muscle health development, non-invasive, and easy to use methods are needed. The aim of the present study was to assess whether multi-frequency Bioimpedance (mfBIA) can be used to detect differences between skeletal muscle of individuals with CP and healthy controls. The mfBIA technique was applied to the medial gastrocnemius muscle of $n = 24$ adults with CP and $n = 20$ healthy controls of both genders. The phase angle (PA) and the centre frequency (fc) were significantly lower in individuals with CP when compared to controls; PA: - 25% for women and - 31.8% for men ($P < 0.0001$); fc: - 5.6% for women and - 5.2% for men ($P < 0.009$). The reactance (Xc) and the extracellular resistance (Re) of skeletal muscle from individuals with CP were significantly higher when compared to controls; Xc: + 9.9% for women and + 28.9% for men ($P < 0.0001$); Re: + 39.7% for women and + 91.2% for men ($P < 0.0001$). The present study shows that several mfBIA parameters differ significantly between individuals with CP and healthy controls. Furthermore, these changes correlated significantly with the severity of CP, as assessed using the GMFCS scale. The present data indicate that mfBIA shows promise in terms of being a useful diagnostic tool, capable of characterizing muscle health and its development in individuals with cerebral palsy.

PMID: [32221759](#)

6. Management of Hip Disorders in Patients with Cerebral Palsy.

Hosseinzadeh P, Baldwin K, Minaie A, Miller F.

JBJS Rev. 2020 Mar;8(3):e0148. doi: 10.2106/JBJS.RVW.19.00148.

PMID: [32224639](#)

7. Development and Content Validity of the Clinical Assessment of Body Alignment for Children With Cerebral Palsy.

George FK, Benham A, Gabriel L, Purton J.

Pediatr Phys Ther. 2020 Apr;32(2):137-143. doi: 10.1097/PEP.0000000000000685.

PURPOSE: The purpose of this study is to describe the development and content validity of the clinical assessment of body alignment (CABA) to measure body alignment in children with cerebral palsy. **METHODS:** Content validity and clinical utility were examined through expert opinion of 283 pediatric physical therapists. Participants reviewed items as matching or not to the domain of body alignment. Clinical utility was evaluated on a 5-point scale. Means and standard deviation were calculated for each attribute. Fleiss' kappa examined interrater reliability of expert responses. **RESULTS:** Percentage agreement was high for 19 items and good for 1 item. Clinicians' ratings showed overall fair to good agreement. Four clinical utility attributes had a net importance score of more than 90%, although interrater reliability was low. **CONCLUSION:** Content validity of the CABA was supported. Construct validity, reliability, and responsiveness require further study. What this adds to the evidence: The CABA has potential to offer clinicians and researchers a clinically practical measure of postural alignment for children with cerebral palsy. Preliminary investigation of CABA shows good content validity. However, more studies to assess the

assessments' psychometrics including construct validity, reliability, and responsiveness are required.

PMID: [32218077](#)

8. Commentary on "Development and Validity of the Clinical Assessment of Body Alignment for Children With Cerebral Palsy".

Santamaria V, Rachwani J.

Pediatr Phys Ther. 2020 Apr;32(2):143. doi: 10.1097/PEP.0000000000000699.

PMID: [32218078](#)

9. Psychometric Properties of Clinical Tests of Balance and Vestibular-Related Function in Children With Cerebral Palsy.

Almutairi AB, Christy JB, Vogtle L.

Pediatr Phys Ther. 2020 Apr;32(2):144-150. doi: 10.1097/PEP.0000000000000682.

PURPOSE: The purpose of this study was to establish the psychometric properties of clinical tests of balance and vestibular-related function in children with cerebral palsy (CP), aged 7 to 12 years, Gross Motor Function Classification System levels I to III. **METHODS:** Forty-two children with CP and 33 children with typical development were examined using Clinical Dynamic Visual Acuity Test, Modified Clinical Test of Sensory Interaction on Balance, Head Impulse Test, Bucket Test, and Northeastern State University College of Optometry oculomotor test. A subgroup was tested twice for reliability. Reference tests included rotary chair and sensory organization test. **RESULTS:** Most children with CP had central rather than peripheral vestibular dysfunction. Clinical tests except Northeastern State University College of Optometry oculomotor test had moderate to good reliability, good sensitivity but poor specificity to identify central vestibular-related impairments. **CONCLUSIONS:** Tests of balance and vestibular-related function may help guide clinical management of children with CP.

PMID: [32218079](#)

10. Commentary on "Psychometric Properties of Clinical Tests of Balance and Vestibular-Related Function in Children With Cerebral Palsy".

Mueller GA, Yungbluth K.

Pediatr Phys Ther. 2020 Apr;32(2):150. doi: 10.1097/PEP.0000000000000700.

PMID: [32218080](#)

11. Muscle capacity to accelerate the body during gait varies with foot position in cerebral palsy.

Hegarty AK, Kurz MJ, Stuberg W, Silverman AK.

Gait Posture. 2020 Feb 20;78:54-59. doi: 10.1016/j.gaitpost.2020.02.014. [Epub ahead of print]

BACKGROUND: Children with cerebral palsy (CP) often have altered gait patterns compared to their typically developing peers. These gait patterns are characterized based on sagittal plane kinematic deviations; however, many children with CP also walk with altered transverse plane kinematics. **RESEARCH QUESTION:** How do both altered skeletal alignment and kinematic deviations affect muscles' capacity to accelerate the body during gait? **METHODS:** A three-dimensional gait analysis was completed for 18 children with spastic CP (12.5 ± 2.9 years; GMFCS level II). Musculoskeletal models were developed for each participant, and tibial torsion, measured during a static standing trial and assessed using motion capture, was incorporated.

An induced acceleration analysis was performed to evaluate the capacity of muscles to accelerate the body center of mass throughout stance. Differences between the root-mean-square muscle capacity for children with CP walking with internally rotated, standard, and externally rotated postures were evaluated. **RESULTS:** Externally rotated postures resulted in a lower capacity to accelerate the body center of mass compared with internally rotated postures. Both changes in skeletal alignment and kinematics contributed to changes in muscle capacity to accelerate the body. **SIGNIFICANCE:** Altered transverse plane skeletal alignment and compensatory kinematics should both be considered in surgical treatment of children with CP.

PMID: [32244189](#)

12. Walking through life with cerebral palsy: reflections on daily walking by adults with cerebral palsy.

Gjesdal BE, Jahnsen R, Morgan P, Opheim A, Mæland S.

Int J Qual Stud Health Well-being. 2020 Dec;15(1):1746577. doi: 10.1080/17482631.2020.1746577.

Purpose: Walking is a major target in childhood physiotherapy for children with cerebral palsy (CP). Little information exists on the importance or value of walking when these children grow up. The aim of this study was to explore personal reflections on daily walking by adults with CP. **Method:** Semi-structured individual interviews were conducted and analysed with systematic text condensation, a four-step thematic cross-case analysis. **Results:** Eight ambulatory adults (26-60 years, four women and four men) with CP were interviewed. Almost all had experienced deteriorated walking ability in adulthood and reported that walking was restricted and affected by intrinsic features, such as pain, fatigue, reduced balance and fear of falling. Extrinsic features such as being looked at due to walking abnormality and environmental factors, such as seasonal changes affected their free walking and was common. Some had accepted using mobility aids for energy conservation. **Conclusions:** Both intrinsic and extrinsic factors influence walking in adults with CP. Reflections by the adults with CP suggest these features may reduce participation in public spaces and potentially increase acceptance and use of mobility aids.

PMID: [32238123](#)

13. High-level motor skills assessment for ambulant children with cerebral palsy: a systematic review and decision tree.

Clutterbuck GL, Auld ML, Johnston LM.

Dev Med Child Neurol. 2020 Apr 1. doi: 10.1111/dmcn.14524. [Epub ahead of print]

AIM: To examine the psychometric evidence for high-level motor skills assessment tools for ambulant, school-aged children with cerebral palsy (CP). **METHOD:** We searched five databases for population (children with CP aged 5-18y in Gross Motor Function Classification System levels I and II), assessment focus (high-level motor skills), and psychometric evidence. We evaluated evidence strength using the number of studies, quality, and conduct according to COnsensus-based Standards for the selection of health status Measurement INstruments checklists. **RESULTS:** Eleven assessments (39 studies) met the criteria. Seven high-level motor skills assessment items (Muscle Power Sprint Test, 10m Shuttle Run Test, 10×5m Sprint Test, vertical jump, standing broad jump, seated throw, and Timed Up and Down Stairs) had strong validity and responsiveness evidence. Jumping items and seated throw lacked reliability data. Four high-level motor skills assessment batteries (Functional Strength Measure in CP, Gross Motor Function Measure-Challenge, Peabody Developmental Motor Scale, and Test of Gross Motor Development, Second Edition) had moderate-to-strong validity and/or reliability evidence. Responsiveness data were only available for the Gross Motor Function Measure-Challenge battery. The decision tree was developed with five levels: clinical feasibility, relevance, tool design, clinical utility, and psychometric properties. **INTERPRETATION:** High-level motor skills assessment tools have strong psychometric evidence for ambulant, school-aged children with CP. The decision tree can assist clinicians and researchers in identifying appropriate tools to measure high-level motor skills.

PMID: [32237147](#)

14. [Research updates on the role and mechanism of motor skills learning in improving motor function in children with cerebral palsy]. [Article in Chinese; Abstract available in Chinese from the publisher]

Wang YX, Xu KS.

Zhonghua Er Ke Za Zhi. 2020 Apr 2;58(4):339-342. doi: 10.3760/cma.j.cn112140-20191128-00758.

PMID: [32234147](#)

15. Foot and Ankle Musculoskeletal Imaging of Pediatric Patients With Cerebral Palsy.

Otjen J, Menashe SJ, Maloney E, Iyer RS, Ngo AV, Sousa TC, Thapa M.

AJR Am J Roentgenol. 2020 Mar 31:1-9. doi: 10.2214/AJR.19.22354. [Epub ahead of print]

OBJECTIVE. Any combination of abnormal positioning of the ankle, hindfoot, midfoot, and forefoot is possible in the context of cerebral palsy, but some patterns are more common than others. The purpose of this article is to discuss the radiographic manifestations and surgical management of the following common conditions: equinus, equinoplanovalgus, equinocavovarus, vertical talus, oblique talus, hallux valgus, and ankle valgus. **CONCLUSION.** CP is defined by abnormalities of the developing fetal or infant brain that result in permanent central motor dysfunction. Foot and ankle deformities are very common in the patients with CP, occurring in up to 93% of such patients as a result of underlying abnormal muscle tone, impaired motor control, and dynamic muscle imbalance. Radiologists must develop knowledge of the most common changes in alignment and basic techniques for correction to better recognize abnormalities and improve communication with orthopedic colleagues.

PMID: [32228327](#)

16. The Human Body Model versus conventional gait models for kinematic gait analysis in children with cerebral palsy.

Flux E, van der Krogt MM, Cappa P, Petrarca M, Desloovere K, Harlaar J.

Hum Mov Sci. 2020 Apr;70:102585. doi: 10.1016/j.humov.2020.102585. Epub 2020 Feb 17.

With the rise of biofeedback in gait training in cerebral palsy there is a need for real-time measurements of gait kinematics. The Human Body Model (HBM) is a recently developed model, optimized for the real-time computing of kinematics. This study evaluated differences between HBM and two commonly used models for clinical gait analysis: the Newington Model, also known as Plug-in-Gait (PiG), and the calibrated anatomical system technique (CAST). Twenty-five children with cerebral palsy participated. 3D instrumented gait analyses were performed in three laboratories across Europe, using a comprehensive retroreflective marker set comprising three models: HBM, PiG and CAST. Gait kinematics from the three models were compared using statistical parametric mapping, and RMSE values were used to quantify differences. The minimal clinically significant difference was set at 5°. Sagittal plane differences were mostly less than 5°. For frontal and transverse planes, differences between all three models for almost all segment and joint angles exceeded the value of minimal clinical significance. Which model holds the most accurate information remains undecided since none of the three models represents a ground truth. Meanwhile, it can be concluded that all three models are equivalent in representing sagittal plane gait kinematics in clinical gait analysis.

PMID: [32217202](#)

17. RaceRunning training improves stamina and promotes skeletal muscle hypertrophy in young individuals with cerebral palsy.

Hjalmarsson E, Fernandez-Gonzalo R, Lidbeck C, Palmcrantz A, Jia A, Kvist O, Pontén E, von Walden F.

BMC Musculoskelet Disord. 2020 Mar 27;21(1):193. doi: 10.1186/s12891-020-03202-8.

BACKGROUND: Individuals with cerebral palsy (CP) are less physically active, spend more time sedentary and have lower cardiorespiratory endurance as compared to typically developed individuals. RaceRunning enables high-intensity exercise in individuals with CP with limited or no walking ability, using a three-wheeled running bike with a saddle and a chest plate for support, but no pedals. Training adaptations using this type of exercise are unknown. **METHODS:** Fifteen adolescents/young adults (mean age 16, range 9-29, 7 females/8 males) with CP completed 12 weeks, two sessions/week, of RaceRunning

training. Measurements of cardiorespiratory endurance (6-min RaceRunning test (6-MRT), average and maximum heart rate, rate of perceived exertion using the Borg scale (Borg-RPE)), skeletal muscle thickness (ultrasound) of the thigh (vastus lateralis and intermedius muscles) and lower leg (medial gastrocnemius muscle) and passive range of motion (pROM) of hip, knee and ankle were collected before and after the training period. RESULTS: Cardiorespiratory endurance increased on average 34% (6-MRT distance; pre 576 ± 320 m vs. post 723 ± 368 m, $p < 0.001$). Average and maximum heart rate and Borg-RPE during the 6-MRT did not differ pre vs. post training. Thickness of the medial gastrocnemius muscle increased 9% in response to training ($p < 0.05$) on the more-affected side. Passive hip flexion increased ($p < 0.05$) on the less-affected side and ankle dorsiflexion decreased ($p < 0.05$) on the more affected side after 12 weeks of RaceRunning training. CONCLUSIONS: These results support the efficacy of RaceRunning as a powerful and effective training modality in individuals with CP, promoting both cardiorespiratory and peripheral adaptations.

PMID: [32220246](#)

18. An Interdisciplinary Model of Treatment of Children with Cerebral Palsy in Poland. Recommendations of the Paediatric Rehabilitation Section of the Polish Rehabilitation Society.

Taczała J, Wolińska O, Becher J, Majcher P.

Ortop Traumatol Rehabil. 2020 Feb 29;22(1):51-59. doi: 10.5604/01.3001.0014.0641.

Medical rehabilitation plays an important leading role in the treatment of children with cerebral palsy (CP). Collaboration between specialists in medical rehabilitation and the rehabilitation team is a prerequisite for good medical care. The quality of medical services for children with CP depends chiefly on the level of expertise of the treatment team. Through training of specialists and sharing of knowledge, we can help more patients. This idea was developed and implemented by Dr Ewa Kooyman-Piskorz, the founder and president of Wandafonds Foundation. Between 2003 and 2014, Dutch specialists working with children with CP conducted a number of training workshops in Poland under the supervision of the Polish Rehabilitation Society and Prof. Jules Becher, a world-famous expert in the rehabilitation of children. Based on these experiences, we present the recommendations of the Paediatric Rehabilitation Section of the Polish Rehabilitation Society regarding an interdisciplinary model of treatment of children with CP in Poland.

PMID: [32242520](#)

19. Non-trauma fracture increases risk for respiratory disease among adults with cerebral palsy.

Whitney DG.

J Orthop Res. 2020 Mar 31. doi: 10.1002/jor.24675. [Epub ahead of print]

Individuals with cerebral palsy (CP) manifest skeletal fragility problems early in life and are vulnerable to nontrauma fracture (NTFx), which may exacerbate the risk of respiratory disease (RD)- the main cause of premature mortality for this population. The purpose of this study was to determine if adults with CP had a greater 12-month risk of RD post-NTFx compared to adults without CP. Data from 2011 to 2017 were leveraged from Optum Clinformatics Data Mart; a claims database from a single private payer in the United States diagnostic codes were used to identify adults (≥ 18 years) with and without CP, NTFx, incident RD, and pre-NTFx cardiometabolic diseases. Cox proportional hazards regression models were used to compare 12-month RD incidence following NTFx with adjustment for sociodemographics and cardiometabolic diseases. Mean age (SD) at baseline was 57.5 (18.4) for adults with CP ($n = 646$) and 61.8 (19.7) for adults without CP ($n = 321,482$). During the follow-up, 172 adults with CP (26.6%) and 73 937 adults without CP (23.0%) developed RD. Adults with CP had higher 12-month post-NTFx RD incidence compared to adults without CP (hazard ratio [HR] = 1.20; 95% confidence interval [CI] = 1.03-1.37). When stratified by the RD subtype, adults with CP had a higher incidence of pneumonia (HR = 2.15; 95% CI = 1.56-2.95), interstitial/pleura disease (HR = 2.13; 95% CI = 1.53-2.96), and other RD (eg, respiratory failure; HR = 2.33; 95% CI = 1.82-2.98), but not acute respiratory infection (HR = 0.93; 95% CI = 0.75-1.15) or chronic obstructive pulmonary disease (HR = 1.15; 95% CI = 0.86-1.53). Among privately insured adults with CP, NTFx is associated with greater risk of RD among adults with vs without CP.

PMID: [32233002](#)

20. Profile of hospital admissions for adults with cerebral palsy: a retrospective cohort study.

Morgan P, Enticott J, Nikam R, Tracy J.

Dev Med Child Neurol. 2020 Apr 1. doi: 10.1111/dmcn.14533. [Epub ahead of print]

AIM: To retrospectively profile acute hospital admissions for a defined cohort of adults with cerebral palsy (CP). **METHOD:** Five years of health service data were interrogated to identify acute health service use by adults with CP. Admission types were described, admission reasons categorized using International Classification of Diseases, 10th Revision codes, and length of stay (LOS) calculated. Any differences between paediatric and adult subsets were explored. **RESULTS:** Individuals with CP constituted 2922 admissions. Of these, 850 (29%) were adult admissions. There were significant differences between admission reasons for paediatric and adult cohorts, with adults predominantly seeking hospital admission for emergency rather than planned care (emergency reason: adults 62.1%, paediatrics 25.2%; $p < 0.001$). The median adult admission LOS was longer than that of children ($p < 0.001$). The primary diagnosis admission reason in the adult data set was respiratory illness (20%) followed closely by gastrostomy dysfunction (19%). **INTERPRETATION:** Adults with CP predominantly access acute hospital services for emergency health care. A high frequency of admissions is associated with respiratory illness and gastrostomy dysfunction in adults with CP. What this paper adds Adults with cerebral palsy (CP) access acute inpatient services for emergency health care. Hospital admissions are predominantly because of respiratory illness and gastrostomy dysfunction. Admission length of stay is longer for adults than children. Many adults with CP require hospitalization more than once a year.

PMID: [32237152](#)**21. Cortical ischaemic patterns in term partial-prolonged hypoxic-ischaemic injury-the inter-arterial watershed demonstrated through atrophy, ulegyria and signal change on delayed MRI scans in children with cerebral palsy.**

Chacko A, Andronikou S, Mian A, Gonçalves FG, Vedajallam S, Thai NJ.

Insights Imaging. 2020 Mar 30;11(1):53. doi: 10.1186/s13244-020-00857-8.

The inter-arterial watershed zone in neonates is a geographic area without discernible anatomic boundaries and difficult to demarcate and usually not featured in atlases. Schematics currently used to depict the areas are not based on any prior anatomic mapping, compared to adults. Magnetic resonance imaging (MRI) of neonates in the acute to subacute phase with suspected hypoxic-ischaemic injury (HII) can demonstrate signal abnormality and restricted diffusion in the cortical and subcortical parenchyma of the watershed regions. In the chronic stage of partial-prolonged hypoxic-ischaemic injury, atrophy and ulegyria can make the watershed zone more conspicuous as a region. Our aim is to use images extracted from a sizable medicolegal database (approximately 2000 cases), of delayed MRI scans in children with cerebral palsy, to demonstrate the watershed region. To achieve this, we have selected cases diagnosed on imaging as having sustained a term pattern of partial-prolonged HII affecting the hemispheric cortex, based on the presence of bilateral, symmetric atrophy with ulegyria. From these, we have identified those patients demonstrating injury along the whole watershed continuum as well as those demonstrating selective anterior or posterior watershed predominant injury for demonstration. Recognition of this zone is essential for diagnosing partial-prolonged hypoxic-ischaemic injury sustained in term neonates. The images presented in this pictorial review provide a template for identifying the cortical watershed distribution when there is milder regional (anterior, parasagittal, peri-Sylvian and posterior) watershed injury and for more severe injury where multiple regions are injured in combination or as a continuum.

PMID: [32232679](#)**22. Association of Preeclampsia in Term Births with Neurodevelopmental Disorders in Offspring.**

Sun BZ, Moster D, Harmon QE, Wilcox AJ.

JAMA Psychiatry. 2020 Apr 1. doi: 10.1001/jamapsychiatry.2020.0306. [Epub ahead of print]

IMPORTANCE: Preeclampsia during pregnancy has been linked to an increased risk of cerebral palsy in offspring. Less is known about the role of preeclampsia in other neurodevelopmental disorders. **OBJECTIVE:** To determine the association between preeclampsia and a range of adverse neurodevelopmental outcomes in offspring after excluding preterm births. **DESIGN, SETTING, AND PARTICIPANTS:** This prospective, population-based cohort study included singleton children

born at term from January 1, 1991, through December 31, 2009, and followed up through December 31, 2014 (to 5 years of age), using Norway's Medical Birth Registry and linked to other demographic, social, and health information by Statistics Norway. Data were analyzed from May 30, 2018, to November 17, 2019. EXPOSURES: Maternal preeclampsia. MAIN OUTCOMES AND MEASURES: Associations between preeclampsia in term pregnancies and cerebral palsy, attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder (ASD), epilepsy, intellectual disability, and vision or hearing loss using multivariable logistic regression. RESULTS: The cohort consisted of 980 560 children born at term (48.8% female and 51.2% male; mean [SD] gestational age, 39.8 [1.4] weeks) with a mean (SD) follow-up of 14.0 (5.6) years. Among these children, 28 068 (2.9%) were exposed to preeclampsia. Exposed children were at increased risk of ADHD (adjusted odds ratio [OR], 1.18; 95% CI, 1.05-1.33), ASD (adjusted OR, 1.29; 95% CI, 1.08-1.54), epilepsy (adjusted OR, 1.50; 95% CI, 1.16-1.93), and intellectual disability (adjusted OR, 1.50; 95% CI, 1.13-1.97); there was also an apparent association between preeclampsia exposure and cerebral palsy (adjusted OR, 1.30; 95% CI, 0.94-1.80). CONCLUSIONS AND RELEVANCE: Preeclampsia is a well-established threat to the mother. Other than the hazards associated with preterm delivery, the risks to offspring from preeclampsia are usually regarded as less important. This study's findings suggest that preeclampsia at term may have lasting effects on neurodevelopment of the child.

PMID: [32236510](#)

23. Phrenic Motor Neuron Loss in an Animal Model of Early Onset Hypertonia.

Brandenburg JE, Fogarty MJ, Brown AD, Sieck GC.

J Neurophysiol. 2020 Apr 1. doi: 10.1152/jn.00026.2020. [Epub ahead of print]

Phrenic motor neuron (PhMN) development in early onset hypertonia is poorly understood. Respiratory disorders are one of the leading causes of morbidity and mortality in individuals with early onset hypertonia, such as cerebral palsy (CP) but are largely overshadowed by a focus on physical function in this condition. Furthermore, while the brain is the focus of CP research, motor neurons, via the motor unit and neurotransmitter signaling, are the targets in clinical interventions for hypertonia. Furthermore, critical periods of spinal cord and motor unit development also coincide with when the supposed brain injury occurs in CP. Using an animal model of early onset spasticity (spa mouse [B6.Cg-Glrbspa/J] with a glycine receptor mutation), we hypothesize that removal of effective glycinergic neurotransmitter inputs to PhMNs during development will result in fewer PhMNs and reduced PhMN somal size at maturity. Adult spa (Glrb^{-/-}) and wild-type (Glrb^{+/+}) mice underwent unilateral retrograde labeling of PhMNs via phrenic nerve dip in tetramethylrhodamine. After three days, mice were euthanized, perfused with 4% paraformaldehyde, and the spinal cord excised and processed for confocal imaging. Spa mice had ~30% fewer PhMNs (P=0.005), disproportionately affecting larger PhMNs. Additionally, a ~22% reduction in PhMN somal surface area (P=0.019), an 18% increase in primary dendrites (P<0.0001), and 24% decrease in dendritic surface area (P=0.014) were observed. Thus, there are fewer larger PhMNs in spa mice. Fewer and smaller PhMNs may contribute to impaired diaphragm neuromotor control and contribute to respiratory morbidity and mortality in conditions of early onset hypertonia.

PMID: [32233911](#)

24. Commentary on "Photo-Based Range-of-Motion Measurement: Reliability and Concurrent Validity in Children With Cerebral Palsy".

Ross SA, Patterson J.

Pediatr Phys Ther. 2020 Apr;32(2):160. doi: 10.1097/PEP.0000000000000698.

PMID: [32218081](#)

25. Commentary on "Perceived Barriers of Modified Ride-On Car Use of Young Children with Disabilities: A Content Analysis".

Yocum A, Hyatt S.

Pediatr Phys Ther. 2020 Apr;32(2):136. doi: 10.1097/PEP.0000000000000695.

PMID: [32218076](#)

26. Commentary on "Challenges Faced by Therapists Providing Services for Infants With or at Risk for Cerebral Palsy".

Campbell PH.

Pediatr Phys Ther. 2020 Apr;32(2):97. doi: 10.1097/PEP.0000000000000701.

PMID: [32218068](#)

Prevention and Cure

27. Antenatal magnesium sulphate for the prevention of cerebral palsy in infants born preterm: a double-blind, randomised, placebo-controlled, multi-centre trial.

Wolf HT, Brok J, Henriksen TB, Greisen G, Salvig JD, Pryds O, Hedegaard M, Weber T, Hegaard HK, Pinborg A, Huusom LD; MASP research group.

BJOG. 2020 Apr 1. doi: 10.1111/1471-0528.16239. [Epub ahead of print]

OBJECTIVE: To study the effect of antenatal magnesium sulphate (MgSO₄) on cerebral palsy (CP) in a manner that also provides adequate power for a linked trial sequential analysis. **DESIGN:** Double-blind, randomised, placebo-controlled, multicentre trial. **SETTING:** Fourteen Danish obstetric departments. **POPULATION:** In total, 560 pregnant women at risk for preterm delivery before 32 weeks of gestation were randomised from December 2011 to January 2018. Those women gave birth to 680 children. **METHODS:** Women were randomised to receive either a loading dose of 5 grams MgSO₄ followed by 1 gram/hour or a placebo in identical volumes. The children were followed up at a corrected age of 18 months or older with a review of their medical charts and with the Ages and Stages Questionnaire. **MAIN OUTCOME MEASURE:** The primary outcome measure was moderate to severe CP. Secondary outcomes included mortality, neonatal morbidity, blindness, and mild CP. **RESULTS:** The crude rates of moderate to severe CP in the MgSO₄ group and the placebo group were 2.0% and 3.3%, respectively. The adjusted odds of moderate to severe CP were lower in the MgSO₄ group than in the placebo group (odds ratio 0.61; 95% confidence interval 0.23-1.65). **CONCLUSIONS:** Antenatal MgSO₄ before 32 weeks of gestation decreases the likelihood of moderate to severe CP, and these results are entirely consistent with other randomised evidence summarised in the linked trial sequential analysis.

PMID: [32237024](#)

28. Magnesium sulphate for foetal neuroprotection at imminent risk for preterm delivery: a systematic review with meta-analysis and trial sequential analysis.

Wolf HT, Huusom LD, Henriksen TB, Hegaard HK, Brok J, Pinborg A.

BJOG. 2020 Mar 31. doi: 10.1111/1471-0528.16238. [Epub ahead of print]

BACKGROUND: Ordinary meta-analyses indicate that magnesium sulphate (MgSO₄) treatment to women at imminent risk for preterm delivery decreases the offspring's risk of cerebral palsy (CP). However, repetitive testing of cumulative data calls for statistical caution, e.g., by trial sequential analysis (TSA), for which there were previously insufficient samples to draw a firm conclusion. Recently, a randomised controlled trial (RCT) provided additional data that potentially increased the sample size such that a new TSA might detect a statistically significant effect. **OBJECTIVES:** To assess the possible foetal neuroprotective effect of MgSO₄ for women at imminent risk for preterm delivery in an updated systematic review with meta-analysis and TSA. **SEARCH STRATEGY:** We searched MEDLINE, Embase, Cochrane and ClinicalTrials.gov on 8 October 2019. The search strategy clustered terms describing the MgSO₄ intervention and preterm delivery. **SELECTION CRITERIA:** RCTS: Data Collection and Analysis: Two reviewers extracted the data. Summary relative risks (RRs) and 95% confidence intervals (CIs) were calculated using fixed-effects models. A TSA was applied to the primary outcome, CP. The quality of the evidence was assessed using GRADE. The protocol was registered in PROSPERO (registration: CRD42019151441). **MAIN**

RESULTS: We identified six eligible trials (5,917 women). MgSO₄ intervention in women at imminent risk for preterm birth decreased the offspring's CP risk (meta-analysis RR 0.68, 95% CI 0.54-0.85; TSA RR 0.69, 95% CI 0.48-0.97).

CONCLUSIONS: This systematic review with meta-analysis and TSA shows conclusively that MgSO₄, when given to women at imminent risk for preterm delivery, decreases the offspring's CP risk.

PMID: [32237069](#)

29. [Effect of ginsenosides on serous metabonomic profiles in cerebral ischemia-reperfusion rats based on ¹H-NMR]. [Article in Chinese]

Cao DM, Guan QX, Liu YL, Wang SM.

Zhongguo Zhong Yao Za Zhi. 2020 Mar;45(5):1142-1148. doi: 10.19540/j.cnki.cjcmm.20190619.505.

Serum metabonomic profiles of the model of focal cerebral ischemia reperfusion is established with the suture-occluded method by Longa to study the effect of ginsenosides. In this study, 48 rats were randomly divided into six groups: sham-operated group, pathological model group, positive drug group (6 mg·kg⁻¹·d⁻¹) and high, medium, low-dose ginsenosides groups (200, 100, 50 mg·kg⁻¹·d⁻¹). They are given intragastric administration respectively with same amount of 0.5% CMC-Na, nimodipine and ginsenoside for 5 days. At 2 h after the final administration, the model was established with the suture-occluded method, and free radical-scavenging activity changes of ginsenoside were observed by maillard reaction, and Longa was possible used as a renoprotective agent-occluded method. At the end of 24 h after the reperfusion, the hemolymph of rats in each group was collected, and the ¹H-NMR spectrum was collected after being treated by certain methods, and analyzed by principal component analysis (PCA). Compared with sham-operated group, pathological model group showed significant increases in the levels of lactate, glutamate, taurine, choline, glucose and methionine, but decreases in the levels of 3-hydroxybutyrate and phosphocreatine/creatine in serum. After treatment with ginsenosides, lipid, 3-hydroxybutyrate and phosphocreatine/creatine were increased in the serum of ginsenosides group rats, but with decreases in lactate and glutamate. The results showed that ginsenosides could regulate metabolic disorders in rats with focal cerebral ischemia reperfusion, and promote a recovery in the process of metabolism. It's helpful to promote the metabolic changes in rats with focal cerebral ischemia reperfusion via ¹H-NMR, and lay a foundation to develop ginsenosides as a new drug to treat ischemic cerebral paralysis.

PMID: [32237458](#)